UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

Health and Safety
District C

Mount Hope, West Virginia
November 9, 1960 wjp

Memorandum

To: W. R. Park, District Supervisor, District C

From: J. L. Gilley, Mining Health and Safety Engineer

Subject: Report on investigation of minor coal-mine bump, No. 2 mine, Chafin Coal Company, Rita, Logan County, West Virginia, September 30, 1960.

A coal-mine bump in the 4 north pillar section of the subject mine at 8:50 a.m., Friday, September 30, 1960, resulted in a few abrasions and contusions of the face and a bruise of the left shoulder of Acey Hurley, a loading-machine operator. After receiving first-aid treatment, Hurley was taken to a hospital in Logan, West Virginia for further treatment and observation. Injuries to Hurley were found to be minor and he was released from the hospital the following morning. The injuries received by the other 7 employees on the section at the time of the bump did not require medical attention.

After receiving information regarding the occurrence of the bump through the Mount Hope Office, District C, the author proceeded to the mine and a joint investigation by company, State and Federal officials was started during the afternoon of September 30, 1960 and was concluded on October 3, 1960.

The No. 2 mine is at Don, approximately 3 miles west of Rita, Logan County, West Virginia and operates in the upper Cedar Grove coal bed through drift openings. The average height of the coal bed on this property is 44 inches. The coal is characteristically black and shiney, possesses a comparatively high degree of hardness and is brittle. The coal shatters or breaks somewhat readily under stress or a blow. Pulverization of the coal by abnormal stress upon the pillars in the immediate area involved in the bump, produced the characteristic dark brown color of bituminous coal. Generally, the face and butt cleavage planes of the coal bed on this property are not pronounced.

A total of 56 men, 49 underground and 9 on the surface, was employed on 2 shifts a day, 5 days a week, and produced a daily average of 1,500 tons of coal, all loaded by mobile loading machines into shuttle cars. The mine, according to the superintendent, has a life expectancy of 11 years.

Development and pillar extraction was by a room-and-pillar method. Present entry development was in groups of 5. Room entries were turned on 460-foot centers off the main entries. Main entries and room entries were on 60- and 50-foot centers, respectively. Rooms were projected on 50-foot centers. Entry crosscuts were on 80-foot centers and crosscuts in rooms were driven on centers ranging from 60 to 80 feet. Present projections (recently revised) require all entries, rooms and crosscuts to be driven 22 feet in width. Entries and rooms are to be driven on 60-foot centers. Previously, entries and crosscuts were projected to be driven 24 feet in width and rooms 26 feet in width. These widths were exceeded at several locations during early development of the 4 north section; consequently, this practice resulted in some of the pillars being unequal in dimension, as will be noted in Sketchs A, B, and C of this report.

The maximum depth of the cover over the coal bed on this property, according to logs of drill holes, is about 846 feet. The irregular crests of the mountain range on the property attain a maximum elevation of 2,093 feet. The immediate roof in the area of the 4 north section involved in the outburst comprises a comparatively strong, nearly horizontal, thinly laminated bed of gray shale 24 to 46 inches in thickness. Logs of several drill holes on the mining property indicate that the structure of the series extending several feet above the coal bed comprises beds predominately of shales, each varying in thickness with definite intervening bedding planes that usually permit easy detachment from the next overlying stratum. The logs of 3 drill holes indicated that the thickness of the overlying shale formations ranged from 17 inches to 49-1/2 feet in some locations and that there are several overlying stratum of sandstone ranging from a few feet to 89 feet in thickness.

The immediate mine floor is predominately hard, firm shale ranging from 15 to 60 inches in thickness underlain generally by a stratum of sandstone ranging up to about 35 feet in thickness. The floor had not heaved in the immediate active workings in the 4 north section; however, the floor had reportedly heaved at several other locations in the mine at various times, including the 4 north territory inby the area involved in the bump. The floor was affected to some degree in the immediate vicinity of the first pillar in No. 4 room by the bump, as indicated in Sketch A of this report.

The method of roof support consisted of one row of posts set on 4-foot centers along each side of the 14-foot-wide roadways in entries, rooms and crosscuts, and a minimum of 2 safety posts at each working face. Breaker and turn timbers were required at the entrance to pillar lifts in addition to one or more rows of posts set on 4-foot centers next to the gob area during the mining of pillar lifts.

The system and the extent of mining and the comparative dimensions of the coal pillars in the 4 north section prior to the coal-mine bump are illustrated in Sketch B. Location of the working faces and of the men and equipment following the outburst and the extent of the area affected are shown in Sketch A.

The method of extracting coal pillars, according to the adopted plan, is by the open-end lift method however, this method had not been followed in extracting a large percentage of the pillars. Normally, pillaring is started as soon as a group of room-panel entries, such as the 4 north entries, have advanced the predetermined distance and a group of 5 rooms at the top end of the panel are completed by driving them abreast their projected distance of 230 feet or until they hole through into previously mined-out area. The system of development and extraction utilized in the 4 north panel is shown in Sketch B. After completion in each successive panel of 5 rooms, the entry-chain pillars are extracted to a point opposite the No. 5 room, then another panel of 5 rooms is developed, as illustrated in Sketch A. This system eventually establishes approximately a flat pillar line, but in the process, development of rooms such as in the 4 north section, is toward the gob in an abutment zone, and in most instances, probably superimposed from 2 mined-out areas, (new and the old adjacent gob lines).

The 4 north entry chain pillars (from the entrance to 4 north to the line of extraction) varied in dimensions from about 35 to 70 feet in length and 20 to 30 feet in width. It will be noted from Sketches A and B that the room pillars likewise varied in dimensions. The room pillars involved in the bump varied from 35 to 80 feet in length and from 24 to 55 feet in width. It will be also noted from Sketches A and B that the No. 4 room pillars on the right side, which were adjacent to the previously mined-out panel of rooms and obviously within a highly stressed zone, were greater in dimensions than any of the surrounding pillars. Furthermore, these 3 pillars likewise varied individually from 45 to 80 feet in length, however, each of them was 55 feet in width.

From Sketch C, it will be noted that during development of the 4 north entries, 4 rooms on 50-foot centers were turned at a distance of 800 feet from the main entry primarily to facilitate ventilation and were driven to intersect the adjacent No. 5 entry (air course) of 3 north. Retreat mining in the 4 north section eventually reduced the 4 north room-panel block between this group of rooms and the 4 north mined-out area (extraction line) to 255 feet in length and 230 feet in width. Furthermore, Sketch C indicates that this comparatively large block of coal was surrounded on 2 sides by gob areas and by numerous small entry-chain and room pillars on the other two sides. It is reasonable to assume that the small pillars acted as yield pillars and likely resulted in this portion of the room-panel block becoming stressed to some degree from all four sides.

Development of this portion of the room-panel block was accomplished by driving 4 rooms abreast on 50-foot centers from the No. 1 entry 4 north directly toward the 3 north gob area. These rooms, except No. 3 room, were driven through to the 3 north gob area by the day shift crew on the day prior to the outburst. The day-shift crew then started a "pillar lift" in the inby pillar in the No. 4 room. In starting this "pillar lift" or pocket, the loose coal, according to the section foreman, was loaded from the pillar with the

loading machine (long 188-C Model) and continued until the coal was too hard to dig. The loading machine was then moved to the adjacent inby pillar in No. 3 room. Several shuttle cars of coal were loaded from this pillar while the cutting machine was cutting the No. 4 room pillar. After cutting operations had been completed, the loading machine was moved back into the No. 4 room pillar and coal-loading in this place was continued until the end of the shift.

The night-shift crew, reportedly, did not load coal in the No. 4 room pillar on the night prior to the bump. They moved the equipment into the inby pillars in Nos. 1 and 2 pillars, but they did not complete the extraction of either one of the pillars, (See Sketch A). Thus, mining of the inby pillars in this panel of rooms was started at each end with most of the coal remaining on a definite point (top end of No. 4 room) where the outburst occurred the following day.

On the morning of the bump, the 4 north crew, comprising 7 workmen and the foreman, arrived on the section at about 7:15 a.m., and soon thereafter, the loading-machine operator moved the machine into the No. 4 room "pillar pocket", started by the day-shift crew the day previously, and started loading (digging) coal from the solid pillar into shuttle cars, (See Sketch A). Two workmen, one of the regular timbermen and a cutting-machine operator, were setting timbers as needed along each side of the loading machine as mining progressed into the pillar. The loading machine was loading coal into a shuttle car and was the only face equipment operating at the time of the bump. Prior to the bump, 36 mine cars ($2\frac{1}{2}$ ton capacity) of coal had been loaded from this pillar. The pillar, incidentally, was 80 feet in length and 55 feet in width, and being the largest of any of the surrounding pillars, was capable of withstanding the greatest stress. When the bump occurred, the foreman, who had only moments before instructed a timberman to set posts preparatory to starting a lift in the second pillar in the No. 4 room, was on his way inby to where the loading machine was operating. The pillar pocket, which was arc-shaped, had been advanced a maximum of 40 feet into the pillar, as shown in Sketch A. Cutting and/or blasting operations had not been performed during the shift prior to the bump.

This outburst was violent in nature and rather extensive, in that a total of 32 pillars was affected to some degree. Coal was expelled violently from the 3 large pillars in No. 4 room; the outburst extended entirely through the first pillar on the right of the No. 4 room roadway, as indicated in Sketch A. Coal was expelled into the roadways from each side of the second line of pillars in Nos. 1, 2, 3, and 4 rooms. The remainder of the pillars were affected to a much lesser degree, in that coal was shaken down from the periphery of some of them and from only one or two sides of others. The roof was not affected in the active area; however, sections of roof, ranging up to 4 feet thick, were shaken down in the mined-out area in Nos. 1 and 2 rooms, and some roof had fallen in the gob area inby No. 4 room, as a result of the bump. Most of the timbers were broken and a very dense cloud of dust was produced throughout the affected area. Equipment was not damaged.

The stress wave was rather intense and the tremor was perceived and heard by mine officials in the mine office on the surface, a distance of approximately 4,000 feet from the scene of the bump. Six of the 8 men on the section (when the bump occurred) were near pillars that were affected and were stunned and thrown off their feet but all miraculously escaped serious injury. The loading-machine operator received small abrasions and contusions about the face and head and a slightly bruised shoulder from flying coal and/or possibly by being thrown against equipment or posts. The section foreman's leg was struck by flying coal, and Harvey Dingess, a timber man, was partially covered by fine coal thrown from the corner of the first pillar on the right in No. 4 room but neither was injured to the extent that medical treatment was required. The workmen, as soon as they gained visibility, assisted the loading-machine operator. He was given first-aid and was taken to the surface thence to a hospital for further treatment and observation. He was released the following day and returned to work the following week.

Reportedly, light bumps, which did not affect the faces and ribs to the extent that coal was expelled with any degree of violence, had occurred during development of this and in the two preceeding panels of rooms in 4 north. However, it was learned from mine officials that a bump, accompanied by a louder report than usual, occurred on September 1, 1960, in the No. 5 room of the previous panel.

From Sketches B and C, it will be noted that coal pillars and pillar remnants of various dimensions were left unmined in the gob areas of 3 north and 4 north. These unmined pillars and pillar remnants undoubtedly delayed and/or prevented the thick overlying roof from caving as desired, thus likely imposing additional stress on the newly developed room pillars, especially the larger pillars in No. 4 room. It was observed during this investigation that the immediate roof stratum, ranging from 30 to about 60 inches in thickness had fallen at some locations in the mined-out area in 4 north; however, the main roof, insofar as could be ascertained, had not caved in that comparatively long spans of the main roof could be seen extending into the gob.

A coal outburst or bump is a cumulative process which manifests itself in one or more ways, but unfortunately its manifestations are not always recognized in time. The natural conditions, the mining methods and practices are primary factors to be considered in dealing with coal-mine bumps, and the bump in this mine on September 30, 1960, is no exception. Circumstances under which this coal-mine bump occurred are evidence that a combination of natural conditions favorable for such occurrences existed in certain areas in this mine. Obviously, this combination in conjunction with other factors such as mining methods and practices that tend to accentuate rather than minimize overstressing or impingement of forces in active pillar areas, is most likely to cause bumps or outbursts with varying degrees of violence. Therefore, where mining is done in the presence of natural conditions favorable for outbursts, every precaution needs to be taken to avoid, insofar as possible, critcial areas through proper mining methods and practices.

From all indications, this coal-mine bump was the result of the imposition of a shock load or a reversal of strain upon pillars that were highly stressed, particularly those in No. 4 room and the middle row of pillars in Nos. 1, 2, 3, and 4 rooms. It is well to reiterate that mining was being done by digging coal with a loading machine from a highly stressed pillar. Furthermore, from Sketch A, it will be noted that the crosscut, which would have divided the long block into 2 pillars had never been completely cut through. Under the circumstances, in all probability, the bump was triggered by stresses from percussion created by the loading arms of the loading machinepenetrating or striking the coal pillar.

It is the opinion of the author that this coal-mine outburst was the result of an accumulative process from a combination of several factors discussed above, and recommendations which are thought will minimize coal-mine outbursts in this mine, and which were discussed with the management during this investigation include:

1. A system of mining should be adopted that will produce the least number of critical areas during retreat mining. Critical areas are produced by pillar line points, pillars not developed sufficiently in advance, improper sequence in development and extraction.

2. Under no circumstances, where the natural conditions are conducive to or favorable for outbursts, should groups of rooms (such as those involved) be driven or developed abreast into stressed areas of coal pillars (abutment pressure zone) toward the gob.

3. The mining system should require that coal pillars be developed as nearly uniform in shape and size as practicable. Consideration should be given to increasing centers of entries and rooms to a minimum of not less than 60 feet.

4. Complete extraction should be striven for and pillar remnants should not be left. If it is not possible to recover such pillar remnants their load-carrying capacity should be destroyed.

5. Pillars should be recovered in a straight line. Irregular pillar lines result in excessive pressures on the pillar line points. (Those jutting into the gobs.) Experience has shown, however, that the lead end (top end) of a pillar line can be kept slightly in advance.

6. Widths of roadways in rooms and entries, including crosscut openings, should be kept to the minimum required by the approved mining plan (entries - 20 feet, rooms - 20 to 24 feet). The adopted mining plans and practices should be complied with at all times.

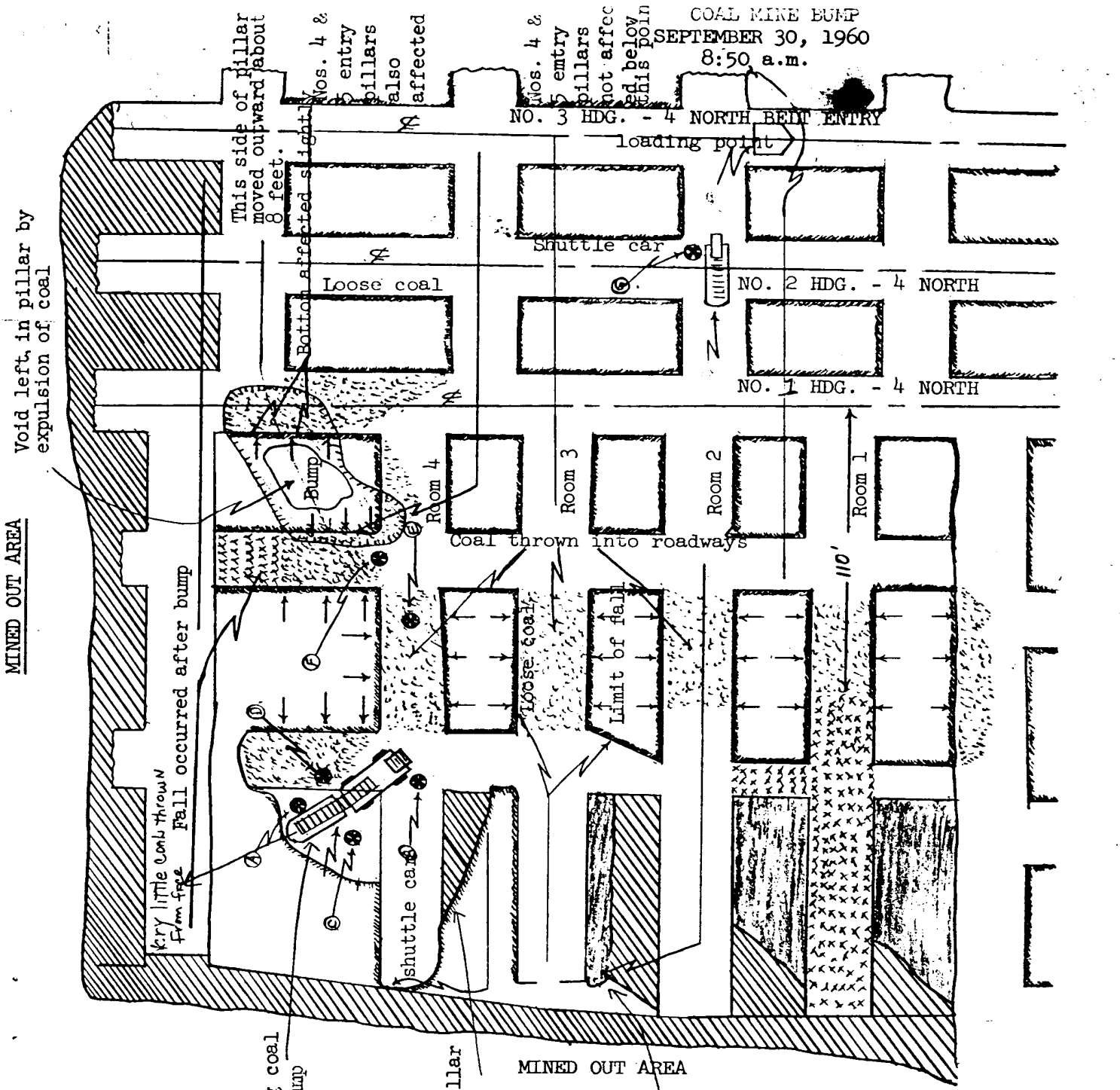
7. Inducer shooting has proven beneficial in the mining of stressed pillars under controlled conditions and the method should be considered.

8. Loading (digging) coal with a loading machine from the ribs of stressed pillars, where conditions are favorable for bumps, should be discontinued.

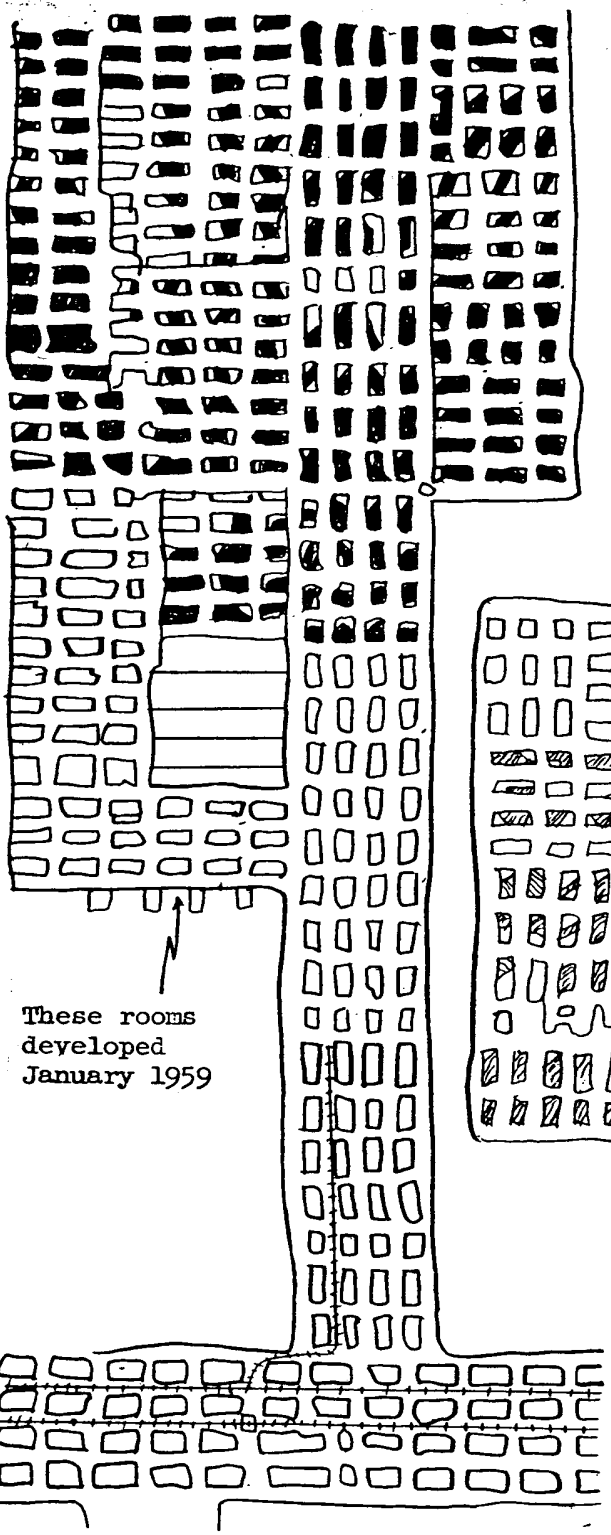
The author gratefully acknowledges the courtesy and cooperation of the employees and mine officials, and Mr. Earl Rutherford of the West Virginia Department of Mines.

/s/ J. L. Gilley

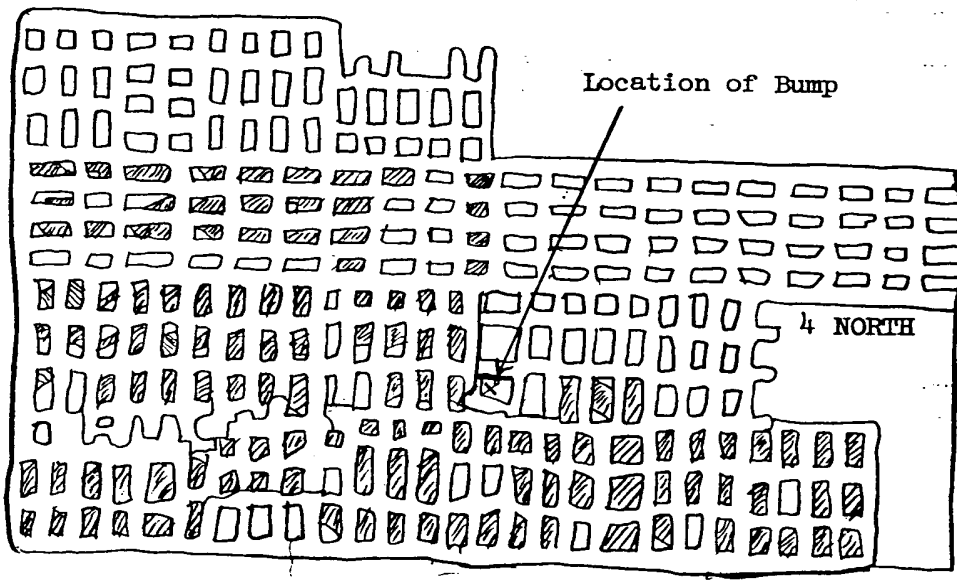
J. L. Gilley
Mining Health and Safety Engineer


COAL MINE BUMP
SEPTEMBER 30, 1960
8:50 a.m.
NO. 3 HDG. - 4 NORTH BELT ENTRY
loading point
Shuttle car
NO. 2 HDG. - 4 NORTH
NO. 1 HDG. - 4 NORTH
Loose coal
Bottom affected slightly
This side of pillar moved outward about 8 feet.
Nos. 4 & 5 entry pillars also affected
Nos. 4 & 5 emtry pillars not affec
ed below this poin
Void left in pillar by expulsion of coal
MINED OUT AREA
Bump
Room 4
Room 3
Room 2
Room 1
Coal thrown into roadways
110'
Loose coal
Limit of fall
Fall occurred after bump
Dry little coal thrown from face
shuttle car
MINED OUT AREA
188 C Long Loading Machine was digging coal from pillar when bump occurred
Coal loaded from this pillar on 9/29 day shift while machine cut No. 4 pillar
No. 2 pillar slabbed as indicated.
Location of Men & Equipment
⊗ Location of Men
a. Loader operator, injured slightl
b. Shuttle car operator
c. Cutter operator
d. timberman
e. section foreman
f. Timberman
g. shuttle car operator
MINE NO. 2
CHAFIN COAL COMPANY
DON, WEST VIRGINIA
SKETCH A
Scale 1" = 50'

SEKTCH C



SKETCH B



ROOM-PANEL BLOCK BEFORE DEVELOPMENT

Scale: 1" = 300'

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